Public Health Briefs

Pesticide Poisoning Surveillance through Regional Poison Control Centers

Debra Kay Olson, RN, MPH, Lynn Sax, Paul Gunderson, PhD, and Leo Sioris, PharmD

ABSTRACT

The purpose of this study is to describe pesticide exposure in the population of callers to Minnesota Regional Poison Centers. Case files from 1988 reporting pesticide exposure to humans were identified in cooperation with the Minnesota Center for Health Statistics. Data analysis was conducted by computer using SAS statistical package.

Of the 1,428 case files indicating pesticide as the primary substance of exposure to Minnesota residents, a mean age of 5 years (range, one month to 85 years) was identified; 50 percent of all cases were below age 3 years. Males accounted for 1.3 times as many cases as females.

Insecticide was identified in the largest percentage of case files (74 percent) followed by herbicide (12 percent), rodenticide (11 percent) and fungicide-nonmedicinal (3 percent). Ingestion was the most common route of exposure; 85 percent of all calls originated from a residence.

While insecticides are still the most common types of pesticide call, herbicide has surpassed insecticide in production and sales in the US. In this study, herbicide type exposure calls present a much different picture than other pesticide types.

The usefulness of poison control centers for examination of pesticide poisoning is explored. Since reporting occurs coincidental with the exposure and its associated symptoms, each pesticide poisoning report could potentially serve as a true sentinel health event. (*Am J Public Health.* 1991;81:750–753)

Introduction

Pesticides represent a large group of chemicals which in general usage are described in terms of the organism they are intended to kill.[1–3] As the use of these chemicals has unfolded, some disquieting phenomena have been observed. A 1984–85 Nebraska study found an annual incidence rate of pesticide-related illness of 1.35 cases per 10,000 population.[4] Lymphoma and leukemia have been associated with higher death rates among Midwestern farmers in regions of high pesticide use[5,6] and Reeves[7] reported 15 children ages 2 to 17 years as having blood dyscrasias developed shortly after inhalation exposure to household insecticides. Pesticides account for a small but important number of acute human poisonings, particularly in a state with substantial use of pesticides in both rural and urban areas, such as Minnesota.[8,9]

Methods

The purpose of this study was to describe pesticide exposure in the 1988 population of callers to Minnesota Regional Poison Control Centers located at Hennepin County Medical Center and St. Paul-Ramsey Medical Center. Centers document exposure data utilizing the Cooperative Poison Center Report Form as designed by the American Association of Poison Control Centers (AAPCC). Data from these report forms were processed through each Center's computer system and sent to the AAPCC's national data collection project in Denver, Colorado. Data tapes containing all of the 1988 data for each Regional Center were then returned to the Minnesota Center for Health Statistics (MCHS) for collation, formatting, and analysis.

In cooperation with the MCHS all Minnesota resident case files from 1988 reporting pesticide exposure to humans were identified. All calls regarding human contact with a chemical coded by the AAPCC to be a herbicide, insecticide, rodenticide, or fungicide (nonmedicinal) were selected. A total of 2,209 calls were classified by the AAPCC system as pesticide exposure calls for Minnesota in 1988, 4.3 percent of all human exposure calls to Minnesota. Of these calls, 1,428 identified pesticides as the primary substance and 31 call files identified pesticides as a secondary substance of human exposure to Minnesota residents. The remaining 750 calls were incomplete data files or lacked the designation as a Minnesota resident, thus were not available for secondary analysis.

The following descriptive analysis applies to the 1,428 call files indicating pesticide as the primary substance of exposure to Minnesota residents in 1988. These data were derived from self-reported information. The use of poison control caller files imposes the following limitations upon the data: an unknown number of pesticide exposure events may occur for which no call was made; voluntary reporting of data via telephone is verified only by

Address reprint requests to Debra Kay Olson, RN, MPH, Instructor, Division of Environmental and Occupational Health, School of Public Health, University of Minnesota, Minneapolis, MN 55455. Coauthors: Sax is Research Specialist, and Dr. Gunderson is Director, both at Minnesota Center for Health Statistics; Dr. Sioris is Director, Minnesota Regional Poison Center and Section of Clinical Pharmacy at St. Paul Ramsey Medical Center, and Assistant Professor, College of Pharmacy, University of Minnesota. This paper, submitted to the Journal June 25, 1990, was revised and accepted for publication January 9, 1991.

TABLE 1—Insecticide Exposure Calls by Primary Substance Category, Minnesota, 1988

Substance	Frequency	Percent
Organophosphate only	220	20.8
Organophosphate in combination with carbamate	71	6.7
Organophosphate in combination with chlorinated hydrocarbon	15	1.4
Organophosphate in combination with other pesticide	7	0.7
Chlorinated hydrocarbon only	116	10.9
Chlorinated hydrocarbon in combination with other pesticide	6	0.6
Borates/boric acid (pesticide only)	29	2.7
Carbamate only	189	17.8
Carbamate in combination with other pesticide	6	0.6
Veterinary pesticides (for pets - flea collars, etc.)	49	4.6
Piperonyl butoxide and pyrethrins in combination (without organophosphate or carbamate)	80	7.5
Pyrethrins only (alone)	59	5.6
Rotenone	5	0.5
Piperonyl butoxide only (alone)	2	0.2
Insect repellants (excluding capsicum containing products)	163	15.4
Other	29	2.7
Unknown	14	1.3
Total	1060	100.0

SOURCE: Hennepin Regional Poison Center and Minnesota Regional Poison Center. Secondary analysis performed by the Minnesota Center for Health Statistics and Public Health Nursing, University of Minnesota.

follow-up phone calls by poison center specialists; data acquired by telephone are limited to those who have access to telephones and knowledge of the poison center service; and by AAPCC definition exposure relates only to suspected contact with any substance(s) which, when inhaled, ingested, applied to, injected into, or developed within the body, may cause damage to structure or disturbance of function to living tissue. An actual poisoning event can only be verified through review of medical outcome.

Results

Insecticide was identified in the largest percentage of case files for Minnesota (1,060 cases, 74 percent) followed by herbicide (168 cases, 12 percent), rodenticide (155 cases, 11 percent), and fungicide-nonmedicinal (45 cases, 3 percent). Of the insecticide cases, those containing organophosphates (alone or in combination) were reported most often (Table 1).

Carbamates were reported in 10 cases of fungicide exposure. Of the remaining fungicide cases, 19 were associated with phthalimide, three with non-mercurial fungicides, and 13 unknown/other.

Herbicide cases were most frequently associated with 2,4-D (2,4-dichlorophenoxyacetic acid) or 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) (78 cases, 46 percent) and triazine herbicides (10 cases, 6 percent). Diquat was associated with 13 cases, carbamate with four cases, and other or unknown with 63 cases.

Rodenticide exposure calls were primarily associated with anticoagulant types (128 cases, 83 percent). Strychnine was associated with three rodenticide exposure calls and the remaining 24 rodenticide cases were other/unknown.

Of the 1,428 cases, a mean age of 5 years (range, one month to 85 years) was identified; 50 percent of all calls were regarding children under the age of 3 years (Table 2). The 13–17 years category accounted for the least number of cases overall. The 18+ years old category accounted for 53 percent of all herbicide-related calls.

Male to female ratio was 1.3:1 ± 0.2 for all pesticide-related calls, as well as for individual pesticide types, except herbicides, where males represented twice the number of cases as females.

Ninety-nine percent of all pesticide calls were reported as unintentional poisonings. General calls (not otherwise specified) accounted for 94 percent (1,323 calls) of the unintentional calls while occupational-related exposure made up 4 percent (62 calls).

Calls originating from a residence accounted for 85 percent of all pesticide poisoning calls. Health care facilities accounted for 11 percent and work place for 3 percent.

Ingestion was the most common route of exposure overall, and for each pesticide type (60 percent), except herbicide, where ingestion accounted for 39 percent and dermal exposure accounted for 45 percent of calls.

Pesticide exposure calls by two-hour interval present a bimodal distribution peaking between 10:00 am and 11:00 am (190 calls, 13 percent) and 6:00 pm and 7:00 pm (251 calls, 18 percent). Calls by two-hour interval by pesticide type show a similar bimodal distribution for each specific type of pesticide. The largest percent of pesticide-related calls occur in the months of May (16 percent), July (15 percent), and August (13 percent) (Table 3).

Thirty-three percent of the calls (468 calls) were documented as symptomatic. Two hundred eighty-eight of these were classified as symptomatic related to the pesticide exposure. By pesticide type, rodenticide calls reported the least number (3 percent) of calls as symptomatic related to the exposure.

Ninety-nine percent of all calls were associated with acute exposures. The majority of calls were managed at a non-health care facility (86 percent) while 12 percent were either managed at (107 calls) or referred to (69 calls) a health care facility. More fungicide cases (93 percent) were managed at a non-health care facility (e.g. managed at home) than any other pesticide type.

Discussion

Since 1986, pesticides have accounted for approximately 4.3 percent of all human exposure calls reported to Minnesota Regional Poison Centers. This is consistent with the percent of calls associated with pesticides nationally as reported by the AAPCC.[8] As such, the state data reported here represent but a small portion of a much larger national picture.

Over the past 20 years in the US, organochlorine insecticides have lost favor because of their long-term health effects and persistence in the environment and have been surpassed in use by organophosphates and carbamates.[10] Acute toxicity related to organophosphate pesticides is usually of rapid onset thus symptoms can be more readily associated with acute exposure to this pesticide type. It is thus not unreasonable that exposure to organophosphate insecticides make up the greatest percent of calls (22 percent) in this study. This is also consistent with a Nebraska study where 25 percent of the emergency room visits and hospitaliza-

TABLE 2—Type of Primary Pesticide Exposure Calls by Age, Minnesota, 1988

	Fungicides		Herbicides		Insecticides		Rodenticides	
Age (years)	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<1	4	0.3	0	0.0	98	6.8	16	1.2
1	8	0.5	11	0.7	197	13.8	57	4.0
2	9	0.6	17	1.1	187	13.1	39	2.7
3	4	0.3	7	0.5	91	6.4	15	1.0
4	1	0.1	5	0.4	39	2.7	2	0.1
5	0	0.0	5	0.4	34	2.4	1	0.1
Unknown child								
2–5	0	0.0	5	0.4	19	1.3	1	0.1
6–12	2	0.1	15	1.0	62	4.3	2	0.1
13–17	1	0.1	8	0.5	17	1.2	2	0.1
18+	15	1.0	89	6.3	302	21.1	14	1.0
Unknown age	1	0.1	6	0.5	14	1.0	6	0.5
Total	45	3.1	168	11.8	1060	74.2	155	10.9

SOURCE: Hennepin Regional Poison Center and Minnesota Regional Poison Center. Secondary analysis performed by the Minnesota Center for Health Statistics and Public Health Nursing, University of Minnesota.

TABLE 3—Type of Primary Pesticide Exposure Calls by Month, Minnesota, 1988

Month	Fungicides	Herbicides	Insecticides	Rodenticides	Row	Total (%)
January	1	—	59	7	67	(4.7)
February	1	—	32	11	44	(3.1)
March	2	2	31	11	46	(3.2)
April	7	11	45	18	81	(5.7)
May	13	58	141	17	229	(16.0)
June	7	43	176	12	238	(16.7)
July	5	21	182	6	214	(15.0)
August	4	22	149	14	189	(13.2)
September	3	8	99	19	129	(9.0)
October	1	2	60	15	78	(5.5)
November	—	—	49	12	61	(4.3)
December	1	1	37	13	52	(3.6)
Total	45	116	1060	155	1428	(100.0)

SOURCE: Hennepin Regional Poison Center and Minnesota Regional Poison Center. Secondary analysis performed by the Minnesota Center for Health Statistics and Public Health Nursing, University of Minnesota.

tions for pesticide-related illness during the 1984–85 crop season were due to organophosphates.[4]

In our study herbicide type exposure calls present a much different picture than other pesticide types. They are typically associated with the adult (18+ years) male experiencing a dermal exposure. With the growing use of herbicides both in agricultural (175 percent increase from 25 years ago[2]) and urban settings the percentage of calls received (0.4 percent of all human exposure calls since 1985) in comparison to exposure potential appears low.[11–14]

Looking at the adult environments of work place (six calls) and type of exposure as occupational (18 calls), the difference in exposure for herbicides by age is not explained. It is still general unintentional residence exposures that account for the majority of herbicide calls in this study. Why this overrepresentation of adults for herbicide exposure calls occurs is an area for further research.

With 50 percent of all calls, examined in this study, reporting pesticide exposure to children under the age of three years, concern arises over long-term effects to this population group. Several authors have explored the long-term effects of such exposures on children.[2,15,16]

Chronic exposure to fungicides has been reported by Moses[2] as posing the greatest risk of cancer as compared to other pesticide types. Thus, while representing only 3 percent of the calls in this study, the cumulative effects of such exposures may have far greater implications.

Blanc and Olson[17] suggest that poison centers are ideally suited to occupational disease surveillance as used for early detection of disease, for timely identification of individual cases, and temporal trends. In this sense, each poison center report could potentially serve as a sentinel health event. Sentinel health events refer to a preventable disease, disability, or untimely death whose occurrence serves as a warning signal that the quality of preventive and/or therapeutic medical care may need to be improved.[18,19]

Acute pesticide poisoning reports, as used in this study, would meet the criteria used by Blanc, *et al*,[17,20] in their investigation of the usefulness of poison center data. Those exposures to pesticides with rapid onset of symptoms, such as in the case of organophosphates, are ideally suited for surveillance through such a system. Reporting occurs coincidental with the exposure and its associated symptoms, and there are no delays as in the case of retrospective surveys. In this

sense, each pesticide poisoning report could potentially serve as a true sentinel health event for the state. □

Acknowledgments

The initial development of the statewide data system was funded by the Minnesota Regional Poison Center and the Medical Education Research Foundation at St. Paul-Ramsey Medical Center in cooperation with the Minnesota Department of Health, Minnesota Center for Health Statistics. Additional support was provided by the University of Minnesota, School of Public Health, Public Health Nursing and BRSG S 07 RR 055448, Biomedical Research Support Grant Program, Division of Research Resources, and National Institutes of Health grant. Analysis of pesticide poisoning exposure data was funded in part by the National Institute for Occupational Safety and Health, Occupational Health Nursing Research Training grant, Midwest Center for Occupational Health and Safety, and the Minnesota Department of Health.

References

1. Zenz C: Occupational Medicine: Principles and Practical Applications. Chicago: Year Book Medical Publishers, 1988.
2. Moses M: Pesticide-related health problems and farmworkers. AAOHNJ 1989; 37(3):115–130.
3. Ware GW: Pesticides: Theory and Application. San Francisco: W.H. Freeman, 1983.
4. Rettig BA, Klein DK, Sniezek JE: The incidence of hospitalizations and emergency room visits resulting from exposure to chemicals used in agriculture. Nebr Med J 1987; 7:215–219.
5. Weisenberger DD: Lymphoid malignancies in Nebraska: A hypothesis. Nebr Med J 1985; 70:300–305.
6. American Medical Association, Council on Scientific Affairs: Council Report: Cancer risk of pesticides in agricultural workers. JAMA 1988; 260:959–966.
7. Reeves JD: Household insecticide-associated blood dyscrasias in children (letter). Am J Pediatr Hematol/Oncol 1982; 4:438–439.
8. Litovitz TL, Schmitz BF, Matyunas N, Martin TG: 1987 Annual Report of the American Association of Poison Control Centers National Data Collection System. Am J Emerg Med 1988; 6:479–515.
9. Minnesota Department of Health, Minnesota Center for Health Statistics: Poison Statistics, Minnesota. Minneapolis, Minnesota, 1987.
10. US Department of Agriculture: Crop and Livestock Pesticide Usage Survey. Economic Research Service, 10S-2, 7–12. Washington, DC: Govt Printing Office, 1983.
11. Marquis JK: Contemporary Issues in Pesticide Toxicology and Pharmacology. Basel, New York: Karger, 1986.
12. Minnesota Agricultural Statistics Service: Pesticides used on Minnesota Farms. St. Paul, Minnesota, 1984.
13. Wasserstrom RF, Wiles R: Field duty: US farmworkers and pesticide safety. Washington, DC: World Resources Institute, 1985.
14. Bureau of National Affairs, Inc: Chemical Regulation Reporter 1990; 0148–7973/90:1289.
15. Gold E, Gordis L, Tonascia J, Szklo M: Risk factors for brain tumors in children. Am J Epidemiol 1979; 109:309–319.
16. Infante PF, Epstein SS, Newton WA Jr: Blood dyscrasias and childhood tumors and exposure to chlordane and heptachlor. Scand J Work, Enviorn Health 1978; 4:137–150.
17. Blanc PD, Olson KR: Occupationally related illness reported to a regional poison control center. Am J Public Health 1986; 76:1303–1307.
18. Rutstein DD, Brenberg W, Chalmers TC, Child III CG, Fishman AP, Perrin EB: Measuring the quality of medical care. N Engl J Med 1976; 294:582–588.
19. Rutstein DD, Mullan RJ, Frazier TM, Halperin WE, Melius JM, Sestito JP: Sentinel health events (occupational): A basis for physician recognition and public health surveillance. Am J Public Health 1988; 73:1054–1062.
20. Blanc PD, Rempel D, Maizlish N, Hiatt P, Olson KR: Occupational illness: Case detection by poison control surveillance. Ann Intern Med 1989; 111:238–244.

Lead Exposure in Outdoor Firearm Instructors

Ram K. Tripathi, PhD, Peter C. Sherertz, PhD, Gerald C. Llewellyn, PhD, and Carl W. Armstrong, MD

ABSTRACT

This study was conducted to determine lead exposure of firearm instructors at an outdoor firing range, while cadets were firing nonjacketed and jacketed lead ammunitions. The breathing zone air for lead exceeded the Occupational Safety and Health Administration standard of 50 $\mu g/m^3$ for two instructors during firing exercises using nonjacketed bullets. The use of totally copper-jacketed bullets reduced the breathing zone lead levels by 92 percent for instructor #1 and by 96 percent for instructor #2; subsequent blood lead levels showed a significant decline in both instructors. (*Am J Public Health.* 1991;81:753–755)

Introduction

Lead poisoning from exposure to airborne lead in indoor firing ranges is an occupational disease of public health concern. Several studies of occupational lead toxicity have been documented at indoor firing ranges.[1–7] The major route of absorption for lead in firing ranges is through inhalation of lead dust and fumes. Inadequate ventilation and lack of personal protective equipment use by instructors may result in lead toxicity.

Instructors assigned to firing ranges are likely to have higher exposures because they may spend significant time in that environment. Several occupational studies have suggested that exposure to lead may be a health risk for users of indoor firing ranges.[8–10] However, the extent of this risk among firearm instructors at outdoor firing ranges has not been documented. This study had two objectives: to evaluate the health risks to instructors from airborne lead exposure from nonjacketed, lead bullets; and to document the reduction or elimination of this risk by using totally copper-jacketed lead ammunition.

Methods

Two instructors, not involved in firing, were studied from June 17 to Septem-

From the Division of Health Hazards Control, Bureau of Toxic Substances, Virginia State Department of Health. Address reprint requests to Ram K. Tripathi, PhD, Virginia Department of Health, Bureau of Toxic Substances, P.O. Box 2448, Richmond, VA 23218. This paper, submitted to the Journal June 11, 1990, was revised and accepted for publication December 5, 1990.